Comparative Study Of One-Day Perioperative Antibiotic Prophylaxis Versus Seven-Day Postoperative Antibiotic Coverage In Elective Surgical Cases

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Citation

P Thejeswi, D Shenoy, L Tauro, S Ram. *Comparative Study Of One-Day Perioperative Antibiotic Prophylaxis Versus Seven-Day Postoperative Antibiotic Coverage In Elective Surgical Cases*. The Internet Journal of Surgery. 2012 Volume 28 Number 2.

Abstract

Aim: Postoperative wound infection remains the most common complication of surgery; routine use of antibiotics for a prolonged period after clean surgery is not justifiable, so an attempt is made to assess the efficacy and advantages of one-day perioperative antibiotic administration versus a seven-day postoperative antibiotic regimen in preventing wound infection and to study the bacteriology of wound infection.Objectives: 1) To assess the efficacy and advantages of one-day perioperative antibiotic administration versus a seven-day postoperative antibiotic regimen in prevention of wound infection after elective surgery. 2) To study the bacteriology of postoperative wound infection. 3) To study the cost efficacy of both regimens.Materials and Methods: A total of 300 patients were included in the study. The patients were divided randomly into 2 groups, each containing 150 patients. Group I patients received 2 doses of antibiotics: one dose half an hour prior to surgery and the next dose 12 hours after the first dose. Group II patients were given antibiotics postoperatively for 7 days. This study was conducted using cephalosporin antibiotics. The wound was inspected on the 3rd, 5th and 7th postoperative day for local erythema, raise in temperature, induration and discharge. Results: The rate of wound infection in group I was 2.66% and in group II it was 4.66%. There was no statistical significance: p-value 0.357 and c^2=0.849. Staph. aureus was the most common organism causing wound infection in 45.5%.Conclusion: One-day perioperative antibiotics are sufficient and cost effective. Postoperative antibiotics are unnecessary.

INTRODUCTION

Postoperative wound infection remains the most common complication of surgery. With the fear of developing wound infection after surgery many surgeons administer antibiotics for a period of 7-10 days even in clean uncontaminated cases. This practice is not only expensive to the patients but also can lead to hospital-acquired infections.

Routine use of antibiotics for a prolonged period after clean surgery is not justifiable. Considerable evidence suggests that antibiotics are used excessively inappropriately in the prevention and treatment of surgical site infections. Antimicrobial prophylaxis that provides coverage throughout the entire perioperative period of risk will reduce not only the risk of wound infections but may also reduce the danger of other types of infectious complications. Timing of prophylaxis is crucial to success, yet antibiotics are often administered at a wrong time or for too long, with implications for the cost of patients care. More rational use of antibiotics is likely to benefit the treatment of future surgical patients.

The purpose of conducting this study is to know whether prophylactic administration of antibiotics can decrease postoperative morbidity, shorten hospitalization, reduce the overall cost attributable to infection and prevent unnecessary use of antibiotics for long periods.

REVIEW OF LITERATURE

Infection of the incised skin or soft tissues is a common but potentially avoidable complication of any surgical procedure. Some bacterial contamination of a surgical site is inevitable, either from the patient's own bacterial flora or from the environment. A UK survey of 157 hospitals carried out in 1993/94 found that the prevalence of wound infection was 2.6% amongst 12,947 patients in eight surgical specialties, varying from 1.5% in neurosurgery to 6.2% in vascular surgery.[1] Extensive medical literature documents

that the appropriate perioperative prophylactic use of antimicrobial agents can reduce the incidence of postoperative wound infections.[7]

Esposito also reported that single-dose prophylaxis are as effective as multiple-dose prophylaxis.[2] More rational use of antibiotics is likely to benefit the treatment of future surgical patients.[3] A trial done by Olak et al. in 1991 on single dose versus six doses of cefazolin prophylaxis in elective general thoracic surgeries resulted in no wound infection in the single-dose group and 2 cases of wound infection in the 6-dose group, thereby supporting the conclusion that six-day cefazolin does not confer a clinically important benefit beyond that obtained from a single dose when it comes to the use of prophylaxis in elective general thoracic surgery.[4]

Classen et al. showed that 3.8% of the patients who received preoperative antibiotics developed wound infections, compared to 3.3% of those who received antibiotics postoperatively. This study concluded that in surgical practice there is considerable variation in the timing of prophylactic administration of antibiotics, and that administration 2 hours before surgery reduces the risk of wound infection.[5]

Controlled clinical trials have shown that antimicrobial prophylaxis can lower the incidence of infection after certain operations, thus reducing morbidity, hospital stay, antibiotic usage and mortality due to sepsis. Infection can be prevented when effective concentrations are present in the blood and the tissue during and shortly after the procedure. Therefore, antimicrobial prophylaxis should be given just before the operations. Beginning earlier is unnecessary and potentially dangerous, beginning later is less effective. A single dose prophylaxis after the induction of anaesthesia is sufficient. Postoperative administration is unnecessary and harmful. Cephalosporins are considered to be the drug of choice because they offer fewer allergic reactions. Ceftriaxone in particular is far exceeding the sale of any other drug for prophylaxis.[6] Duration of surgery is also found to be an important factor in predicting wound sepsis.[7-11]

Keighley showed that the rate of wound infection following single-dose preoperative cefazolin is lower (3.2%) than with five-day postoperative antibiotic therapy (5.5%). The first dose of any broad-spectrum antibiotic should be given immediately before or during the operative procedure because delayed wound contamination of the incised wound is very unlikely. Thus, it is likely that postoperative antibiotic therapy does not have any role in prevention of wound infection.[12]

Zahid et al. showed that a single dose of preoperative cefotaxime in cholecystectomy is as effective as three doses of cefotaxime in prevention of wound infection. The single-dose group had only 4% wound infections whereas the three-dose group had 5.25% wound infections.[13]

Esposito evaluated 17565 patients and showed that development of surgical site infection in patients using ceftriaxone is rarer compared to other antibiotics in clean surgeries; 5.1% of patients developed surgical site infection (SSI) in the ceftriaxone group while 6.2% developed such infections in the comparator group. Thus, ceftriaxone is the antibiotic of choice in surgical prophylaxis.[14] A comparative study was conducted by Toderov, Mancher and Atanassov[15] in which patients were divided into 2 groups: Group I (n=92) patients received a 24-hour antibiotic prophylaxis and group II (n=98) patients had a prolonged antibiotic cover that lasted 5 days. The antibiotic prophylaxis was conducted with a 3 rd generation cephalosporin and metronidazole. The results showed postoperative wound infection in 13 (15.2%) patients from group I and in 25 (25.5%) patients from group II. The difference did not reach statistical significance ($p>0.05\%$). The results of the study showed no advantage of the prolonged antibiotic prophylaxis. Based on the study findings, the authors suggested that a 24-hour antibiotic prophylaxis should be recommended for the lower rate of side effects and lower cost. These factors justify the use of a pre-operative dose of 3 rd generation cephalosporin for economical benefits.

MATERIALS AND METHODS

This study was conducted at Father Muller medical College Hospital, in the Surgery Department. Patients undergoing clean elective surgery were included. A total of 300 patients were included and divided into 2 groups at random.

Group I: Patients receiving 2 doses of antibiotics, one dose ½ hour prior to surgery and another dose 12 hours after the first dose. In this study, injection ceftriaxone 1g i.v. was used.

Group II: Patients belonging to this group were given only postoperative antibiotics immediately after surgery and continued for 7 days: 2 days i.v. Ceftriaxone and later oral cephalosporin antibiotics (cefodroxil, 500mg twice daily given for 5 days).

INCLUSION CRITERIA

EXCLUSION CRITERIA

PREOPERATIVE PREPARATION

The patients were admitted one day prior to surgery and all necessary investigations were done. The operative area was shaved on the night prior to the operation and patients were told to take a bath using soap in the morning on the day of operation.

ASEPTIC PRECAUTION IN THE OPERATION THEATRE

All the necessary aseptic precautions were followed such as using autoclaved gowns, sterile disposable gloves, sterile instruments, drapes. Standard surgical scrub for 5 to 10 minutes was practiced before performing operations.

OPERATIVE TECHNIQUES

The operative area was cleaned with povidine iodine and with spirit. The principles of surgery were followed in all cases, such as minimum tissue handling, maintaining of adequate homeostasis and minimum use of cautery. Drains were used wherever necessary; closure was done with suture materials, clips and steristrips. Neosporin ointment was used for local application and wounds were closed with adhesive dressing.

POSTOPERATIVE CARE

The patients were followed up daily. A temperature chart was maintained and the patients were observed for systemic infections like respiratory tract infection and urinary tract infection (UTI). Wound dressings were opened on the third postoperative day and checked for signs of wound infection like local erythema, induration, local rise of temperature or discharge. The wound was covered with Neosporin ointment dressing. The inspection of the wound was repeated on the fifth and seventh postoperative day. All the sutures were removed on the seventh postoperative day if there was no wound infection and we looked for stitch abscesses or gaping. If an infection was noted, the sutures were removed earlier, discharge was sent for culture and sensitivity testing and daily betadine dressings were done. Healex spray was applied to the wound at the time of discharge from hospital.

OBSERVATION AND RESULTS

The nature of surgery the patients have undergone is shown in table1.

Figure 1

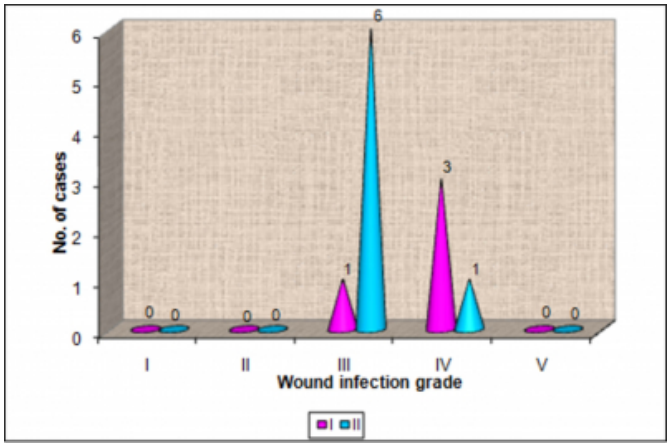
Table 1: Surgical Procedures

Name of the surgery	No. of cases in group 1	No. of cases in group 2
1. Thyroidectomy	33 (22.0%)	34 (22.66%)
2. Hernioplasty	41 (27.33%)	43 (28.66%)
3. Herniorrhaphy	10 (6.66%)	10 (6.66%)
4. Laparoscopic cholecystectomy	11 (7.33%)	11 (7.33%)
5. Paraumbilical hernia repair	8 (5.33%)	8 (5.33%)
6. Epigastric hernia repair	4 (2.66%)	3 (2.00%)
7. Incisional hernia repair	9 (6.00%)	9 (6.00%)
8. Varicose vein surgery	6 (4.00%)	5 (3.33%)
9. Fibroadenoma excision	9 (6.00%)	8 (5.33%)
10. Circumcision	4 (2.66%)	4 (2.66%)
11. Varicocelectomy	5 (3.33%)	4 (2.66%)
12. Hydrocele sac excision & eversion	10 (6.66%)	11 (7.33%)
Total	150 (100%)	150 (100%)

Thyroidectomy and Hernioplasty patients constituted the major group in this study. The incidence of wound infection in group I patients was 4 (2.66%) and in group II it was 7 (4.66%; χ^2=0.849, p value=0.357, which is not statistically significant).

Figure 2

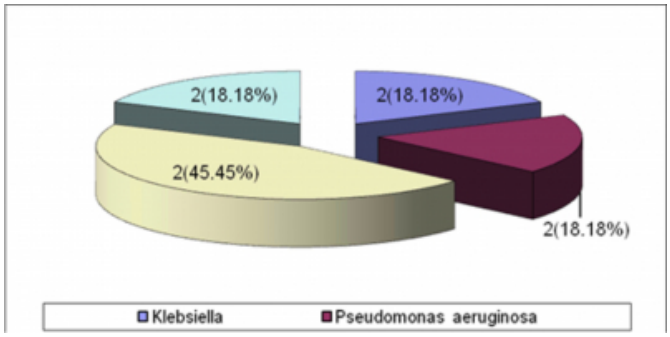
Figure 1: Grades of wound infection



In group I, grade IV infection was more common, compared to group II, where Grade III infection was predominant.

Figure 3

Figure 2: Profile of microorganisms isolated from the infected wounds



Staph. aureus is the most common organism causing wound infection.

The overall cost in Group I is Rs. 98, whereas in Group II it is Rs.266 (which is significant).

Table 2 Gender Predilection of Wound Infection

Figure 4

Gender	Infection		Total
	Absent	Present	
Female	117 (97.50%)	3 (2.50%)	120 (100%)
Male	172 (95.55%)	8 (4.44%)	180 (100%)
Total	289 (96.33%)	11 (3.66%)	300 (100%)

Three females and 8 males had wound infections (χ^2= 0.771, p=0.380, which is not statistically significant).

Figure 5

Table 3 Wound Infection in Patients with Drain

Drain	Infection		Total
	Absent	Present	
Present	113 (95.76%)	5 (4.23%)	118 (100%)
Absent	176 (96.70%)	6 (3.29%)	182 (100%)
Total	289 (96.33%)	11 (3.66%)	300 (100%)

Five patients with drains and 6 patients without drain had infections (χ^2= 0.179, p = 0.672, which is not statistically significant).

DISCUSSION

With the advent of antibiotics and their widespread use, the incidence of wound infection has come down remarkably. Pre-operative administration of antibiotics to prevent post-operative infection represents a cornerstone in modern medicine.

Controlled clinical trials have shown that antimicrobial prophylaxis can lower the incidence of infection after certain operations, thus reducing morbidity, hospital stay, antibiotic usage and mortality due to sepsis. An effective prophylactic regimen should be directed against the most likely infecting organisms. Infections can be prevented when effective concentrations of the drug are present in the blood and the tissue during and shortly after the procedure. Therefore, antibiotic prophylaxis should begin just before the operation. Beginning earlier was found to be unnecessary and potentially dangerous, while beginning later was found to be less effective.[7] A single dose prophylaxis before the surgery was found to be sufficient. If surgery is delayed or prolonged, often a second dose is advisable if an antimicrobial agent with short life is used. Post-operative administration is unnecessary and harmful.

Pre-operative use of antibiotics to prevent wound infection was demonstrated by Bernard and Cole (1964)[16]. Wound infection results during the operative procedure. Hence, a potential bacterial infection can be prevented greatly if the antibiotics are circulating in the tissues before the bacteria invade, justifying the use of preoperative antibiotics. In this respect, cephalosporins have been considered to be the drug of choice because they have fewer allergic reactions. Ceftriaxone is far exceeding the use of other drugs for prophylaxis.

The rate of wound infection in the 300 patients was 3.66%. Group I showed an infection rate of 2.66%, whereas group II showed an infection rate of 4.66%, thus indicating a lower infection rate in pre-operative antibiotic prophylaxis.

In our study, out of the 300 patients, 181 were male and 120 were female. Eight (4.44%) male and three (2.50%) female patients developed post-operative infections. The p-value was 0.380 and hence the difference in gender with regards to development of infection was not significant. Postoperative wound infection was found to be more common with 50-55 years in our study. Hence, age also plays an important role in the development of infections. Of the 300 cases in our study, 118 patients had a drain following the surgery and 182 patients did not. Five (4.23%) patients with drain developed infections whereas six (3.29%) patients without drain developed postoperative infection. The p-value was 0.672 and thus it can be concluded that the presence or absence of drain does not contribute to the infection rate.

A study conducted by Classen et al. has shown that patients who received pre-operative antibiotics early developed 3.8% wound infections. Patients who received antibiotics perioperatively developed 1.45% infections compared to those who received antibiotic postoperatively and developed 3.3% wound infections.[5] The administration of antibiotics 2 to 24 hours before the surgical incision was defined as early; that during the 2 hours before incision as pre-operative, that during the three hours after the incision as perioperative and that more than 3 hours but less than 24 hours after the incision as postoperative. This study concludes that in surgical practice there is considerable variation in the timing of prophylactic administration of antibiotics and the administration in the 2 hours before surgery reduces the risk of wound infection.

To find out the economical saving achieved with the right prophylaxis to prevent surgical wound infections, a study

was done by Fernandez[17]. A total of 5260 patients operated during 1990-93 were included. Making constant all variables, i.e immunodeficiency, incorrect healing, re-operated patients, type of surgery and wrong prophylaxis, the percentage of infection prevented by right prophylaxis and the cost was evaluated starting from the number of extra days of infection. The number of extra days of infection prevented during 4 years was 310, saving a total of 194 million pesetas (1.5 million dollars), due to right prophylaxis. Cost benefit ratio was 1/17. Hence the right prophylaxis is of utmost importance in order to avoid the development of infections.[17]

A study was conducted at the medical center in southern Taiwan to investigate the amount and cost of surgical prophylaxis in order to determine an appropriate course of action to control antibiotic use and decrease the burden of resistance. The results showed that the average duration of antibiotic use was 6.4 days. The duration of hospital stay cannot be commented upon in our study because most of the patients are admitted 2 to 3 days prior to the surgery for academic interest and the patients are often discharged at a much later date after the surgery on patient request or for their convenience.

Prophylaxis was extended for one day in 80% of patients and three days in 68.2%. The most common regimen was cefazolin and gentamycin used in 75.3% of procedures. There were post-operative infections in 3.8% of patients. The most common post-operative infection was at the surgical site. Aerobic gram negative bacilli were most common (54.3%) followed by gram positive cocci (34.6%), anaerobes (8.6%) and yeast (2.4%). The total cost of prophylactic antibiotics was approximately 169,862 US dollars. Had a single dose of cefazolin been used for all patients, the cost would have been reduced by 92.1%. This study documented the excessive use and often inappropriate timing of administration of antibiotics for surgical prophylaxis, thus increasing the cost and emergence of resistant micro-organisms. Our study also showed an economical advantage in using only 2 doses of perioperative antibiotic prophylaxis.

The American guidelines[18] for surgical prophylaxis, worked out recently by the CDC, have not modified their general structure and have strongly influenced the protocols and the prescriptive behaviour of other countries. These guidelines, however, are probably no longer adequate for the situation in question. Evidence from sensual sources would extend the administrability of antibiotic prophylaxis to other clean surgeries. The evolution of bacterial epidemiology and bacterial resistance and the contemporary availability of new antibiotics have removed the fear of the post-antibiotic era. In clinical trials, in some cases and for some risk patients it would appear justified to use 3 rd generation cephalosporins and especially ceftriaxone which, because of its peculiar pharmacokinetic characteristics, guarantees with a single dose the same efficacy as that of 3 doses of other cephalosporins.

A study conducted in Turkey[3] shows that there is considerable evidence that antibiotics are used excessively and inappropriately in the prevention and treatment of hospital-acquired infections. In the case of the latter, timing of the prophylaxis is crucial to success, yet antibiotics are administered at the wrong time or for a long period, with implications for the cost of the patient care. More rational use of antibiotics is likely to benefit the treatment of future surgical patients by reducing the pressure to select for antibiotic resistant bacterial pathogens.

A comparison of single dose and 3 doses antibiotic prophylaxis with cefotaxime sodium in cholecystectomy was done in the Pakistan Institute of Medical Science, Islamabad, from October 2000 to March 2002.[13] Intravenous cefotaxime sodium as a prophylaxis was used in 150 patients who underwent elective cholecystectomy. Half of the patients were given a single dose one hour before surgery (group A) while the other half (group B) was given 3 doses, the 1 st one 1 hour before surgery, the 2 nd and 3 rd ones were given at an 8-hour interval after surgery. Inappropriate use of antibiotic prophylaxis is common, e.g. incorrect timing, duration and use of oral antibiotics. The timing of the 1 st dose is very important and improper timing is one of the most common problems in surgical prophylaxis. The study included all the patients operated electively for cholelithiasis, between 18-65 years of age, without any regard to sex. Three patients in group A and four in group B got wound infections. The difference was not statistically significant. However, a single pre-operative dose can be recommended in cholecystectomy as it is less costly and has the same prophylactic benefits as of a single dose.[13]

Incidence of wound infection following clean surgery is 1.8% as claimed by Cruse and Foord.[19] As most of the wound infections are detected within three days after surgery, this indicates that these infections are acquired during operative procedure. The contaminating bacteria

could have been present either in the skin or were inoculated during surgery.[20,21] In our study, standard skin preparation was done for all patients, which decreased the exogenous bacterial load; however, the organisms situated deep within the skin pores cannot be eliminated completely. Various authors have studied the efficacy of single-dose antibiotics in preventing wound sepsis/infection.

Figure 6

Table 4: Results of other similar studies

Serial no.	Workers	Year	% of infection
1.	Sanchez ubeda[22]	1958	5.6%
2.	Johnstone[23]	1962	8.7%
3.	Snider[24]	1968	2.3%

All the above studies support the results of the present study that a 1-day perioperative antibiotic prophylaxis is almost as effective as multiple-dose prophylaxis. Hence, a single-day prophylaxis is recommended to reduce the financial burdens, the emergence of resistant strains and to avoid the side effects of the drugs.

However, it is of utmost importance that complete asepsis be maintained during the surgery and post-operative care, irrespective of the antibiotic prophylaxis, to achieve the much desired goal of elimination of post-operative infections; thus reducing the morbidity and mortality.

CONCLUSION

Two-dose antibiotics are sufficient in preventing wound infection. Prolonged administration of antibiotics is unnecessary and costlier. Wound infection is equal in both sexes and not associated with sex predominance. Presence or absence of drain does not contribute to the infection rate. Prolonged use of antibiotics is associated with emergence of resistant strains and superinfections, which can be prevented by cost-effective short-term antibiotic prophylaxis.

LIMITING FACTORS

Many other factors also play a major role in preventing surgical site infection. It can be prevented by

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